ESTIMATION OF EXPOSURE OF PERSONS IN CALIFORNIA TO PESTICIDE PRODUCTS THAT CONTAIN TRALOMETHRIN

by

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ABSTRACT

Tralomethrin is a new active ingredient for several home and agricultural products. This chemical is intended for use to control various pests indoors, outdoors, and in cotton. The major metabolite of tralomethrin in animals is deltamethrin. A mean dermal absorption rate obtained from a study in male rats was 7.2%. Estimated absorbed daily dosages (ADD, µg/kg/day) that resulted from an aerial application in cotton were 0.82 for mixers/loaders, 0.49 for applicators and 0.18 for flaggers. For ground boom application, ADD (µg/kg/day) for mixers/loaders was 0.02 and that for applicators was 0.06. Cotton scouts would be experiencing an ADD of 0.48 µg/kg/day when gloves are not used or 0.27 µg/kg/day when gloves are used. Infants playing on treated surfaces, either applied by home owners or pest control operators, would be experiencing high exposure potential. Lower ADD (0.38 µg/kg/day) was estimated for infants playing in a room following crack, crevice or spot application, whereas higher ADD (3.04 µg/kg/day) was estimated for infants playing in a room after a broadcast application by a pest control operator. Tralomethrin is in the risk assessment process because of possible adverse health effects to humans. Tralomethrin has been shown to cause tremor induction (acute toxicity), exaggerated reflexes (sub-chronic toxicity), and tremors and ataxia (chronic toxicity) in experimental animals.

This report was prepared for use in the Department's Risk Characterization Document for tralomethrin.

California Environmental Protection Agency
Department of Pesticide Regulation
Worker Health and Safety Branch

Human Exposure Assessment

Tralomethrin

June 6, 1995

INTRODUCTION

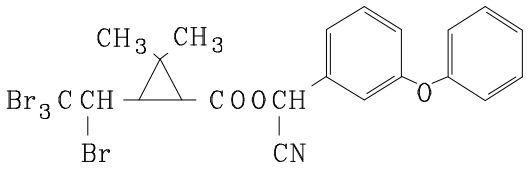
Human exposure assessment provides essential information for the risk assessment of pesticides in the registration process. The exposure estimates contained in this document will be used as part of the risk characterization document of the Department of Pesticide Regulation (DPR). It will also be used as a basis for mitigation proposals if exposures to tralomethrin are found to cause excessive risk.

Direct exposure studies using tralomethrin were not available. All exposure estimates as reported in this document were derived from surrogate data obtained from various sources. In addition to exposure estimates, presentation of other properties of tralomethrin are necessary for a better understanding of its nature, usage and effects. These additional categories are physical and chemical properties, regulatory history, technical and product formulations, label precautions, usage, worker illnesses, dermal sensitization, dermal absorption, and pharmacokinetic/animal metabolism.

PHYSICAL AND CHEMICAL PROPERTIES

1.	Chemical Name:	((S-alpha-cyano-3-phenoxybenzyl (1R,3S)-2,2-dimethyl-3-[(RS)-1,2,2,2-tetrabromoethyl]-cyclopropanecarboxylate
2.	Common Name:	Tralomethrin
3.	Trade Names:	Scout X-TRA™; Tracker®; Saga®; Dethmor®; Chemsico® Home Insect Control; Hot Shot Rid-a-Bug®; Spectracide ™
4.	Empirical Formula:	$C_{22}H_{19}Br_4NO_3$
5.	CAS Registry Number:	66841-25-6
6.	Molecular Weight:	665

7. Structural Formula:



8.	Specific Gravity:	0.948g per mL at 20°C (Scout X-TRA™) 1.032g per mL at 20°C (Technical)
9.	Physical State:	Yellow to beige resin (Technical)
9.	Boiling Point	Not applicable
10.	Solubility:	Soluble in most organic solvents, but relatively insoluble in water (i.e., 0.026 ppm in 30 minutes, 0.036 ppm in 24 hours)
11.	Vapor Pressure:	4.6×10^{-13} mmHg at 25°C
12.	Octanol/Water Partition Coefficient:	3.5×10^{4} at 25°C
13.	Henry's Law Constant:	5.04×10^{-12} atm/m^3/mole
14.	pH:	6.8 (in a 1% aqueous dispersion)

(Hoechst-Roussel, 1987,1988a-d)

REGULATORY HISTORY

No tralomethrin products are currently registered in California. On September 18, 1985, a tolerance of 0.20 ppm (parts per million) for the combined residues of tramomethrin and its primary metabolites was established for the raw agricultural commodity cottonseed. On June 17, 1987, a tolerance of 0.05 ppm for the combined residues of tralomethrin and its metabolites calculated as parent in or on the raw agricultural commodity soybeans was established. On June 29, 1988 and amended on June 30, 1989 a tolerance of 0.20 ppm for the combined residues of tralomethrin and its metabolites calculated as parent in or on the food commodity cottonseed oil, when present as a result of application of the insecticide to the growing crops was established.

TECHNICAL AND PRODUCT FORMULATIONS

Nine product formulations containing tralomethrin as the active ingredient (a.i.) have been submitted to DPR for registration in California. Two of these products (Scout X-TRA™, and SAGA® WP) are marketed by Hoechst-Roussel. The remaining 7 formulations (Hot Shot® Rid a Bug® Flea & Tick Killer, Hot Shot® Rid a Bug® Home Insect Killer, Hot Shot® Roach and Ant Killer 2, Hot Shot® Roach and Ant Killer 3, Hot Shot® Triple Strength Roach and Ant Killer, Spectracide® Flea and Tick Killer 2, Spectracide® Home Insect Control 3) are marketed by Spectrum Group, United Industries Corporation. The nine products, with EPA registration numbers and the percent active ingredient, are presented in Table 1.

Table 1. Tralomethrin products.

Product Name	**% Active Ingredient**
Scout X-TRA™ (EPA Reg No. 34147-3-54382)	11.40
SAGA® WP (EPA Reg No. 432-755)	40.00
Hot Shot® Rid a Bug® Flea & Tick Killer (9688-81-8845)	0.025
Hot Shot® Rid a Bug® Home Insect Killer (EPA Reg No. 9688-80-8845)	0.01
Hot Shot® Roach and Ant Killer 2* (9688-86-8845)	0.01
Hot Shot® Roach and Ant Killer 3 (EPA Reg No. 9688-80-8845)	0.01
Hot Shot® Triple Strength Roach and Ant Killer* (EPA Reg No. 9688-79-8845)	0.03
Spectracide® Flea and Tick Killer 2 (EPA Reg No. 9688-87-8845)	0.03
Spectracide® Home Insect Control 3 (EPA Reg No. 9688-81-8845)	0.025

LABEL PRECAUTIONS

All seven home use products (Hot Shot® and Spectracide®) with active ingredients ranging from 0.01 to 0.03% are Toxicity Category III pesticides with the signal word "CAUTION". Product labels do not inform users to wear any protective clothing or equipment. Saga™, a product intended for use by residential pest control operators (PCOs), is a Toxicity Category II pesticide bearing the signal word "WARNING"; the PCOs must wear eye protection when handling this product.

Scout X-TRA™, which is for use in cotton, is a Toxicity Category I pesticide bearing the signal word "DANGER". Handlers of this product must wear, in addition to work clothing (long-sleeved shirts, long pants, shoes plus socks), chemical-resistant gloves (such as barrier laminate or viton ≥ 14 mils), protective eyewear. Worker entry into treated areas is prohibited within 24 hours after application, unless coveralls, chemical-resistant gloves, socks and shoes, and protective eyewear are worn. The product label shows these statements “Corrosive, causes irreversible eye damage. Can cause irritation to skin such as burning and tingling. Do not get in eyes, or skin or on clothing. May be fatal if swallowed. Harmful if inhaled or absorbed through skin. Do not breathe vapor.” The label also gives these suggestions “Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product’s concentrate. Do not reuse them.”

USAGE

Scout X-TRA™ is sold as a liquid that contains 11.40% tralomethrin. It is intended for use on cotton to combat a variety of insects. The application rates for use on cotton range from 0.016 to 0.024 pounds (lbs) a.i./acre (2.28 to 3.41 fluid ounces/acre). The first application is to be made before insect populations are significant. Subsequent applications can be made as needed. The total number of applications to cotton crops in a single growing season is restricted to 10. It is very unlikely that 10 applications will be made in a season for several reasons, such as cost of insecticide, propensity to develop resistance with frequent application, and competition with other pyrethroids. Scout X-TRA™ may be applied in tank mixtures with other products approved for use on cotton. This includes the following synthetic pyrethroids: AMBUSH®, AMMO® 2.5EC, ASANA® XL, BAYTHROID® 2, CAPTURE® 2EC, CYMBUSH®, DANITOL® 2.4 EC, FURY™ 1.5EC, KARATE®, MUSTANG®, POUNCE® 2.3EC. Scout X-TRA™ may be applied by aerial or ground application. The total amount of Scout X-TRA™ that may be applied to cotton in a single growing season is 0.19 pounds a.i./acre (27 fluid ounces/acre). Scout X-TRA™ may not be applied within 28 days of harvest for cotton. Applicators and other handlers must wear a long-sleeved shirt and long pants, chemical-resistant gloves, shoes plus socks, and protective eyewear.

SAGA® WP is intended for use by professional applicators in and around residential and nonresidential structures and their immediate surroundings and on various modes of transportation. SAGA® WP is intended to be mixed with water and applied with hand pressurized or power operated sprayers as a course spray. The application concentrations of

tralomethrin may vary from 0.03 to 0.06% w/w (0.1 to 0.2 ounce SAGA® WP/gallon of water). Treatments may be repeated as necessary to maintain adequate pest control. The remaining "Hot Shot®" and "Spectracide®" products are ready-to-use, do-it-yourself, water based formulations with 0.01 to 0.03 % active ingredient.

WORKER ILLNESSES

There are no reported illnesses from tralomethrin in California. The toxicity of deltamethrin (the primary tralomethrin metabolite) to humans has been documented. He *et al*. (1989) reviewed 325 cases of deltamethrin poisonings (occupational 158, accidental 167) which were reported in the Chinese medical literatures from 1983 to 1988. These cases were reported from 14 provinces in the People's Republic of China. Oral ingestion has been associated with epigastric pain, nausea, vomiting, coarse muscular fasciculaitons, and coma. Workers exposed to deltamethrin during its manufacture experienced cutaneous and mucous membrane irritation.

DERMAL SENSITIZATION

Contact hypersensitivity studies of Scout® insecticide were conducted using four preparations of RU 25474 identified as technical product, second formulation, formulation, and matrix (Hoechst-Roussel, 1985). Albino guinea pigs of the Hartley/Dunkin strain, approximately 4 - 6 weeks of age, were used in the studies. These animals were induced with appropriate concentrations of test substances either by topical treatment or injection method. Subsequently, each animal was challenged with appropriate preparations of RU 25474 doses. Numeric scores were awarded for dermal reactions of erythema and edema. These reactions were compared to that observed during the induction phase. The results showed that test substances used in the studies did not produce any evidence of delayed contact hypersensitivity.

A similar study was conducted in male short-haired albino guinea pigs using 0.03% Tralomethrin Microemulsion LCSF-111. The results of the study revealed that a sensitization reaction was not produced by the undiluted test material (Spectrum Group, 1991). A dermal sensitization study of tralomethrin 40% WP was tested in male albino guinea pigs by using a 5% solution in deionized water. The result indicated that the test article as prepared did not appear to be a skin sensitizer (Roussel UCLAF, 1993).

DERMAL ABSORPTION

A dermal absorption study of tralomethrin in male rats was conducted by Hazleton Wisconsin, Inc. This study was performed according to the study protocol, which was reviewed by the Worker Health and Safety Branch, Department of Pesticide Regulation. The study was also conducted in compliance with Good Laboratory Practice standards. Six week old male Sprague-Dawley rats (Charles River Crl:CD®BR) were used in the definitive phase of the study. Body weights of these rats ranged from 220 to 242 grams. These animals were inspected and

acclimatized prior to the study. One day prior to the study, the backs and shoulders of each rat were shaved and the shaved areas were washed with acetone. A plastic enclosure was affixed to the shaved area to define the treated area, which was approximately 12.5 cm^2. An Elizabethan collar was placed on the animal's neck to prevent it from licking the treated skin site.

Three dose levels and one control were used in this study. The dose was prepared by adding the appropriate amounts of high purity ^{14}C-tralomethrin (>95% pure) and non-labeled tralomethrin to a blank formulation and suspended in Megapure water. The final doses were 0.037, 0.378, and 1.18 mg/animal equivalent to 3, 30, and 95 $\mu g/cm^2$. After administration of the test material, the treated skin site was covered with a nonocclusive cover made with filter paper.

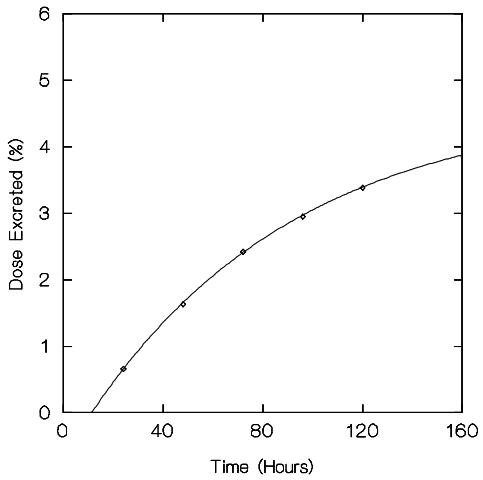
The sacrifice times for the definitive phase of the study were: 0.5, 1, 2, 4, 10, 24, and 120 hours. For the 24- and 120-hour sacrifice times, treated skin sites were washed with 2% Ivory soap solution ten hours after exposure; daily urine and feces samples were collected and analyzed separately. Samples collected for analysis were: nonocclusive covers, dose enclosures, skin washings, treated skin sites, cage washings, cage wipes, carcasses, feces, and urine.

The results of the study were reviewed and percent of dermal absorption was determined (Thongsinthusak, 1993). The results indicated that dermal absorption of tralomethrin is dose dependent, i.e., percent dose absorbed for the low dose is higher than that for the medium and high doses. Furthermore, percent dose absorbed is greater for the longer exposure and sacrifice times for the same dose level. A low percent of dose (range 0.07-0.78) was observed in carcasses for all dose groups and sacrifice times. The highest percent dose in the treated skin site was 24.3% at 10-hour sacrifice time for the low dose, whereas, for medium and high doses residues were 6.71 and 4.97% 10-hour after dosing, respectively.

Excretion kinetics of tralomethrin in urine and feces from treated rats were observed for 120 hours after dosing. Percent of dose excreted at different time intervals were tabulated. In order to resolve the issue of bound skin residue, cumulative percent doses in urine and feces for different time intervals extrapolated beyond 120 hours were used for estimating the asymptote by employing an exponential saturation model with lag time. An equation representing this model is: Y = A*(1-EXP(-B*(X+C))) or Recov = Max*(1-EXP(-Rate*(Time+Lag))). An example of the plots using Intelligent Software Systat® (Systat®, Inc., 1994) for the lowest dose and the outputs are shown in Figure 1. The dermal absorption value is the sum of percent dose at asymptote (maximum or "A" term) and percent of dose recovered in carcass, blood, and cage washings/cage wipes. The percent of dose in the blood in this case is negligible. Table 2 summarizes the dermal absorption values for low, medium and high doses obtained from this study. The adjusted dermal absorption values for the lowest dose (3 $\mu g/cm^2$) of 7.2% is appropriate to use in the exposure estimates. This lowest dose should be more representative than the medium (30 $\mu g/cm^2$) or high dose (95 $\mu g/cm^2$) for the exposure experienced by agricultural workers or consumers.

Figure 1. Asymptotic plot of cumulative excretion of dose of tralomethrin in urine and feces at different time intervals for 3 μg/cm^2 dose.

$$Y = 4.6549*(1-EXP(-0.0119*(X-11.2803)))$$



Statistics:

```
>MODEL RECOV=Max*(1-EXP(-Rate*(Time+Lag)))
>ESTIMATE/ ITER= 25 START= 4,.011,.1 SIMPLEX SCALE

FRI 6/04/93 1:37:18 PM   C:\TCSYS\TRALOM02.SYS

 ITERATION      LOSS      PARAMETER VALUES
    0      .4423074D+00  .4000D+01 .1100D-01 .1000D+00
    1      .2924814D+00  .4873D+01 .8706D-02 .1538D+00
    2      .1058626D+00  .6004D+01 .6795D-02 .1650D+00
    3      .7113534D-01  .6571D+01 .6012D-02 .1847D+00
    4      .6071989D-01  .7566D+01 .5059D-02-.4267D-02
    5      .5877466D-01  .8229D+01 .4550D-02-.1789D+00
    6      .5832284D-01  .8565D+01 .4349D-02-.4303D+00
    7      .5710997D-01  .8394D+01 .4531D-02-.1194D+01
    8      .4308329D-01  .7452D+01 .5442D-02-.4603D+01
    9      .3753377D-01  .6969D+01 .6101D-02-.6778D+01
   10      .3108027D-01  .6429D+01 .6682D-02-.5969D+01
   11      .2390916D-01  .6266D+01 .7173D-02-.7450D+01
   12      .1822321D-01  .5625D+01 .8358D-02-.8481D+01
   13      .1037538D-01  .5273D+01 .9430D-02-.8637D+01
   14      .3036110D-02  .4697D+01 .1154D-01-.1062D+02
   15      .1298963D-02  .4684D+01 .1174D-01-.1104D+02
   16      .1027378D-02  .4642D+01 .1199D-01-.1136D+02
   17      .1013248D-02  .4654D+01 .1192D-01-.1129D+02
   18      .1013029D-02  .4655D+01 .1191D-01-.1128D+02
   19      .1013022D-02  .4655D+01 .1191D-01-.1128D+02
   20      .1013022D-02  .4655D+01 .1191D-01-.1128D+02

DEPENDENT VARIABLE IS    RECOV
  SOURCE   SUM-OF-SQUARES    DF  MEAN-SQUARE

 REGRESSION       29.0748    3      9.6916
  RESIDUAL         0.0010    2      0.0005

    TOTAL        29.0758    5
 CORRECTED        4.6995    4

    RAW R-SQUARED (1-RESIDUAL/TOTAL)    =      1.0000
CORRECTED R-SQUARED (1-RESIDUAL/CORRECTED) =      0.9998
STANDARD ERRORS OF PARAMETERS ARE RESCALED


PARAMETER  ESTIMATE   A.S.E.   LOWER <95%> UPPER
   MAX        4.6549     3.0174     -1.2591     10.5689
  RATE        0.0119     0.0147     -0.0169      0.0408
   LAG      -11.2803    18.2102    -46.9716     24.4111


ASYMPTOTIC CORRELATION MATRIX OF PARAMETERS

              MAX       RATE       LAG

   MAX         1.0000
  RATE        -0.9587     1.0000
   LAG         0.4454    -0.6272     1.0000
```

Table 2. Summary of tralomethrin dermal absorption values for low, medium and high doses.

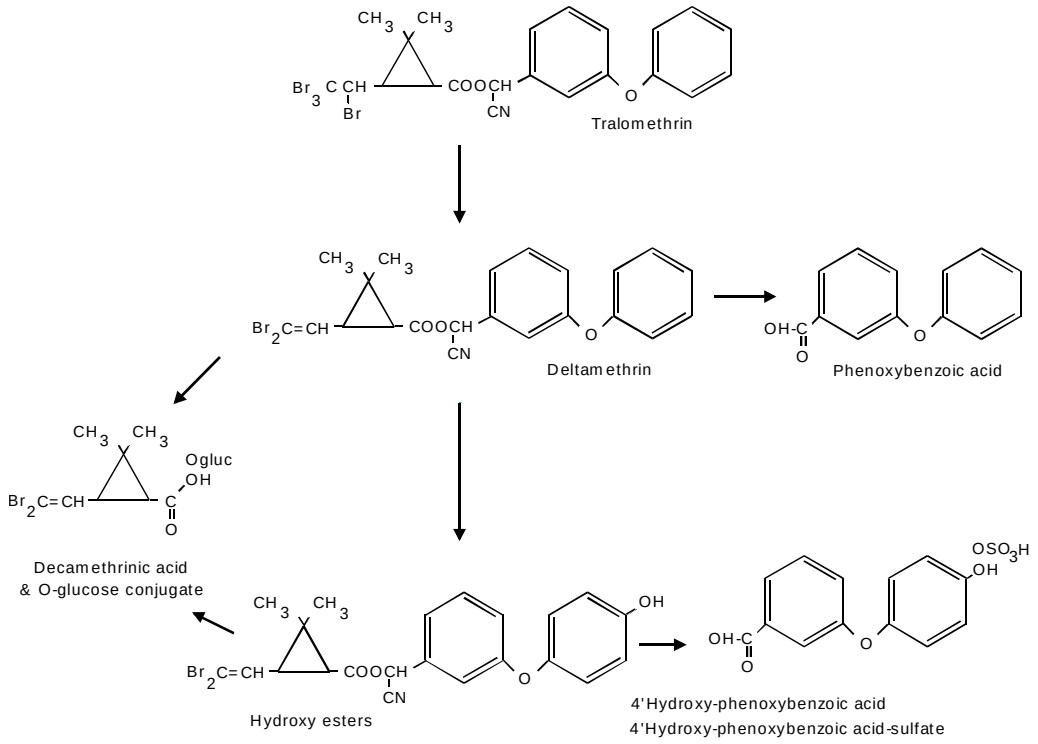
		Percent of dose					
				Excretion at			Adjusted*
Dose	($\mu g/cm^2$)	CW/CW	Carcass	asymptote	Total	% Recovery	% Dermal absorption
Low	3	1.74	0.37	4.66	6.77	94.6	7.2
Medium	30	1.09	0.31	1.82	3.22	99.8	3.2
High	95	0.56	0.36	1.89	2.81	97.7	2.9

CW/CW = Cage washings/Cage wipes * Adjusted for percent recovery

PHARMACOKINETICS/ANIMAL METABOLISM

The metabolism of tralomethrin by rats has been extensively studied by Cole *et al*. (1982) and Bosch (1990). Tralomethrin is generally not detected in treated animals or their excreta since it undergoes rapid and essentially complete debromination (at the 1-ethyl position) to form deltamethrin (Figure 2).

Figure 2. Tralomethrin: Proposed metabolic pathway in rats.



Deltamethrin is further metabolized by cleavage of the ester bond and hydroxylation on the 4' position (Bosch, 1990). The majority of the products resulting from cleavage of the ester bond are conjugated before being excreted in the urine. Based on cumulative recovery profiles, the majority of the radioactivity (from ^{14}C labeled tralomethrin) was eliminated from the rat, in the urine and feces, within the first 24 hours after dosing. Radioactivity retained in tissues and carcasses 7 days post treatment ranged from 0.5% to 1.5% of the administered dosages.

EXPOSURE ASSESSMENT

Exposure studies using tralomethrin for aerial and ground applications in agriculture, residential pest control, and for home occupants are not available. Estimation of exposures were exclusively derived from several surrogate studies. For an aerial application, the registrant submitted a surrogate exposure study employing deltamethrin (Decis® 5.0 EC) (Hoechst-Roussel, 1992). Deltamethrin is a major metabolite of tralomethrin in animals as well as in the environment. For exposure of workers during a ground boom application, an exposure study for EPTC conducted by Knaak *et al*. (1989) was submitted as a surrogate. However, EPTC is a herbicide and has a high vapor pressure. Alternatively, exposure estimates determined for fenpropathrin (Dong, 1994) were used as surrogate data. These exposure data were originally estimated by U.S. EPA (Kutney, 1989; Lunchick, 1988). Dislodgeable foliar residue (DFR) data for tralomethrin on cotton foliage were not available for the estimation of exposure for cotton scouts. Consequently, exposure estimates for cotton scouts were derived from averaged DFR, which were used for bifenthrin (Dong *et al*., 1991) and fenpropathrin (Dong, 1994), and transfer factors (TF) from the studies of Ware *et al.* (1973, 1974, 1975). The latter studies were previously evaluated by Dong *et al.* (1991).

For PCO, a biological monitoring study using chlorpyrifos (Gibbons *et al*., 1993) was employed as a surrogate. Exposures of home occupants (adults and infants) were estimated from a broadcast application study using chlorpyrifos (Vacarro *et al*., 1991). The results of this study were previously evaluated by Thongsinthusak *et al*. (1993a). An exposure estimate for propoxur (Sanborn, 1994), which resulted from the application of 1% aerosol, was used as a surrogate for crack, crevice and spot applications by home owners. Exposures of home occupants (adults and infants) were estimated from dislodgeable residue on treated carpet and transfer efficiency of the residue (Vacarro *et al*., 1991).

The exposure data obtained from the above mentioned surrogates, as shown in subsequent sections, were adjusted whenever applicable for factors related to the use of tralomethrin, such as application rate, default body weight and dermal absorption rates. The exposure estimates contained in this document will be revised if exposure studies employing tralomethrin become available.

1. Use of tralomethrin in agricultural pest control

A. Agriculture: aerial application

Diluted Decis® 5.0 EC in water was applied at a rate of four grams a.i./acre (0.0088 lbs a.i./acre). The application volume of finished spray was 1.17 gallons/acre (4.4 L/acre). Fields of various grain crops were sprayed using a typical fixed-wing aircraft. Eight replicates, each for mixer/loader or applicator exposure monitoring, were performed at each of two sites (Yorkton and Moose Jaw) in Saskatchewan, Canada. Workers wore conventional work clothing, which were long-sleeved coveralls/flight suits or long pants and shirts, shoes or boots, respirators, goggles and caps. Mixers/loaders wore chemical-resistant gloves, whereas pilots wore fire-resistant gloves. Dermal exposure (exclusive of the feet, face, front of neck, and hands) was estimated from residues on 100% cotton long union suits worn underneath each worker's conventional clothing. Exposure to the feet was estimated from residues on 80% cotton/20% polyester short anklet socks worn underneath typical work socks. Exposure of the head and face, "V" of the chest, and back of neck was estimated from residues on 100% cotton glove fabric dosimeter with exposed surface area of approximately 60 cm^2 each. These dosimeters were attached to the worker's hat (or pilot's helmet), just to the right of the center of the "V" of the chest, and the back of the neck. Exposure of hands protected under chemical- or fire-resistant gloves worn by mixers/loaders and pilots, respectively, was estimated from the protected bare hand and the protected cotton glove worn additionally on the other hand. Residues on the bare hand were measured by washing three times with a 250 aliquot each of 1:1 distilled water:isopropanol solution. All measured residues from each type of dosimeter were adjusted with the corresponding mean recoveries (ranging from 92% to 105%) from field fortification, which was done using Decis® 5.0 EC diluted in water.

Inhalation exposure was monitored during the operation by using 600-mg organic vapor charcoal tubes, which were attached to personal air pumps. However, these samples were not analyzed because the analytical lab could not find a suitable solvent for extracting deltamethrin residues from charcoal tubes. Inhalation exposure of mixers/loaders and applicators during aerial application of chlorothalonil (Thongsinthusak, 1993b) was used as a surrogate.

The number of days per use season for pesticide in cotton was determined to be 62 days (Thongsinthusak *et al.*, 1993a). This use period was determined from a report given by Meinders *et al.* (1991). The number of workdays per season or per year is 50 days (Hoechst-Roussel, 1992). This number of workdays is similar to that used for bifenthrin (Dong *et al.*, 1991) or fenpropathrin (Dong, 1994), which was 40 days. Workdays for various work tasks are shown in the footnotes of Table 8.

A.1 Mixers/loaders (M/L)

Eight mixers/loaders were monitored with a total of eight replicates at two sites. Each replicate consisted of mixing/loading one to three tank loads of diluted Decis® 5.0 EC. During the work activity of mixing/loading, a worker poured the test material directly from its container(s) into the mixing drum. The container(s) was triple rinsed and the rinsate was transferred into the drum

using a hose, and topped off the drum with water. The mixture was then pumped to the spray tank; additional water was pumped through the drum to the spray tank to top it off. The task of the mixer/loader was completed after uncoupling the feed hose and pulling it away from the airplane. There were two replicates that aircraft were loaded using typical open-pour loading equipment where a mixer/loader measured a formulation into a plastic beaker, walking along the wing of the aircraft to the hatch of the spray tank, poured the content of the beaker directly through the hatch into the spray tank. Water was then filled the tank to the mark. Amount of deltamethrin handled per replicate ranged from 0.31 to 3 kg a.i. (0.7-6.6 lbs). The mixing tank consisted of a 200-L metal drum from which the mixed formulation was pumped into the spray tank. Each mixer was assumed to have provided service to two planes covering an application of 1,000 acres per day. Exposure estimates are shown in Table 3. Absorbed dosages (ADD - Absorbed Daily Dosage; SADD - Seasonal Average Daily Dosage; AADD - Annual Average Daily Dosage; LADD - Lifetime Average Daily Dosage) are shown in Table 8.

A.2 Applicator (A)

Eight applicators (pilots) were monitored for a total of sixteen replicates at two sites. Each replicate consisted of applying one to three tank loads of diluted Decis® 5.0 EC. Each pilot was assumed to have made an application to 500 acres per day. Five different types of fixed-wing aircraft were used. The aircraft had 450-600-L capacity stainless steel tanks. Each spray boom was equipped with 22-30 D6/C45 nozzles and was operated at an altitude of about 2.5-3 meters. Results of the exposure studies are shown in Table 3. Absorbed dosages are shown in Table 8.

A.3 Flaggers

Dermal exposure of flaggers estimated for fenpropathrin was used as a surrogate. The exposure was originally estimated by Lunchick (1988). The average and the highest dermal exposure of flaggers to fenpropathrin were estimated to be 0.013 and 0.075 mg/kg/day, respectively (Dong, 1994). Fenpropathrin was applied at a rate of 0.3 lbs a.i./acre, whereas for tralomethrin, it is 0.024 lbs a.i./acre. The surrogate exposures were adjusted for the difference in application rates. Therefore, average tralomethrin dermal exposure = 0.013 mg/kg BW/day (fenpropathrin) x 0.024 lbs a.i./acre (tralomethrin)/0.3 lbs a.i./acre (fenpropathrin) = 0.001 mg/kg BW/day (tralomethrin).

Inhalation exposure of flaggers to chlorothalonil of 1.1 mg/person/day (Thongsinthusak, 1993b) was used as a surrogate. The application rate for chlorothalonil was 2.22 lbs a.i./acre. Thus, inhalation exposure of flaggers to tralomethrin was estimated to be 11.9 µg/person/day. The exposure estimates for flaggers are shown in Table 8.

Table 3. Dermal/inhalation exposure of mixers/loaders and applicators to tralomethrin by body part during aerial application[a].

Body part	Dermal/inhalation exposure (Average ± SD)			
	Mixer/loaders[b]		Applicators[c]	
	(µg/kg BW/lb a.i.)	(µg/person/day)	(µg/kg BW/lb a.i.)	(µg/person/day)
Feet	0.024 ± 0.016		0.025 ± 0.021	
Upper + Lower body	0.155 ± 0.297		0.333 ± 0.653	
Hands (Hand wash + Gloves)	0.112 ± 0.231		0.149 ± 0.197	
Head[d] + "V"[e] + Neck	0.054 ± 0.059[f]		0.046 ± 0.047	
Total dermal exposure	0.345 ± 0.378[f]	628 ± 689[g]	0.553 ± 0.750	504 ± 683[h]
Inhalation exposure	0.019 ±0.008	35 ± 15[g]	0.002 ± 0.001	1.7 ± 0.5[h]

[a] Deltamethrin application rate = 0.0088 lbs a.i./acre. Tralomethrin application rate = 0.024 lbs a.i./acre. Adult male body weight (BW) = 75.9 kg (U.S. EPA, 1985).
[b] A M/L handled 24 lbs a.i./day (enough to treat 1,000 acres).
[c] A pilot applied 12 lbs a.i./day (enough to cover 500 acres).
[d] Head includes face.
[e] "V" = "V" of chest.
[f] Excluded a statistical outlier; the data from the chest dosimeter sample in the M/L replicate 2 was determined to be a statistical outlier, i.e., > 5 SDs (or > 99.99th percentile value) from the mean calculated without the outlier.
[g] Total exposure (µg/kg BW/lb a.i.) x 24 lbs a.i. handled/day x 75.9 kg BW.
[h] Total exposure (µg/kg BW/lb a.i.) x 12 lbs a.i. handled/day x 75.9 kg BW.

B. Agriculture: ground boom application

The exposure data generated for fenpropathrin on cotton (Dong, 1994) was used as a surrogate. Both the average exposure and the highest reported exposure rates were used to calculate the expected exposure and the upper-bound values (the highest exposure rates). The maximum application rate for fenpropathrin used in the estimation of exposure was 0.3 lbs a.i./acre, whereas the maximum label rate for tralomethrin in cotton is 0.024 lbs a.i./acre. The surrogate exposure data were adjusted for the difference in application rates to obtain tralomethrin exposure estimate. The assumption that inhalation exposures from bifenthrin applied to cotton were negligible compared to dermal exposure (Lunchick, 1988) was followed. Exposure estimates for tralomethrin are shown in Table 4. Absorbed dosages for tralomethrin are shown in Table 8.

C. Cotton scouts

In March of 1995, the registrant submitted a DFR study protocol and its revised version for cotton, tomatoes, and lettuce (AgrEvo, 1995). The proposed study protocols were reviewed and suggestions were offered (Thongsinthusak and Ross, 1995; Thongsinthusak, 1995). At present, exposure estimates for cotton scouts are needed for the ongoing risk assessment process for tralomethrin. Therefore, surrogate DFR data and transfer factors were used for the estimation of exposure of cotton scouts.

It is typical that cotton scouts (or pest control advisers) may enter treated fields to determine the effectiveness of pest control. The exposure of cotton scouts to tralomethrin is assumed to have occurred 24 hours after an aerial or ground application, at which time the sprays have dried. Cotton scouts are not required to wear protective clothing as indicated on the product label to enter a treated field after the sprays have dried or 24 hours after application.

Table 4. Dermal exposure of mixers/loaders and applicators to tralomethrin during ground boom application.

Work Task		Fenpropathrin[a] dermal exposure (µg/kg BW/day)	Tralomethrin[b] dermal exposure (µg/kg BW/day)	Tralomethrin[c] dermal exposure (µg/person/day)
M/L:	Average	3	0.20	15.2
	Upper bounds[d]	7	0.60	45.5
A:	Average	10	0.80	61
	Upper bounds[d]	76	6.1	463

[a] Fenpropathrin maximum application rate is 0.3 lbs a.i./acre.

[b] Tralomethrin maximum application rate is 0.024 lbs a.i./acre. Dermal exposure (tralomethrin) = Dermal exposure (fenpropathrin) x 0.024 lbs a.i./acre ÷ 0.3 lbs a.i./acre (fenpropathrin).

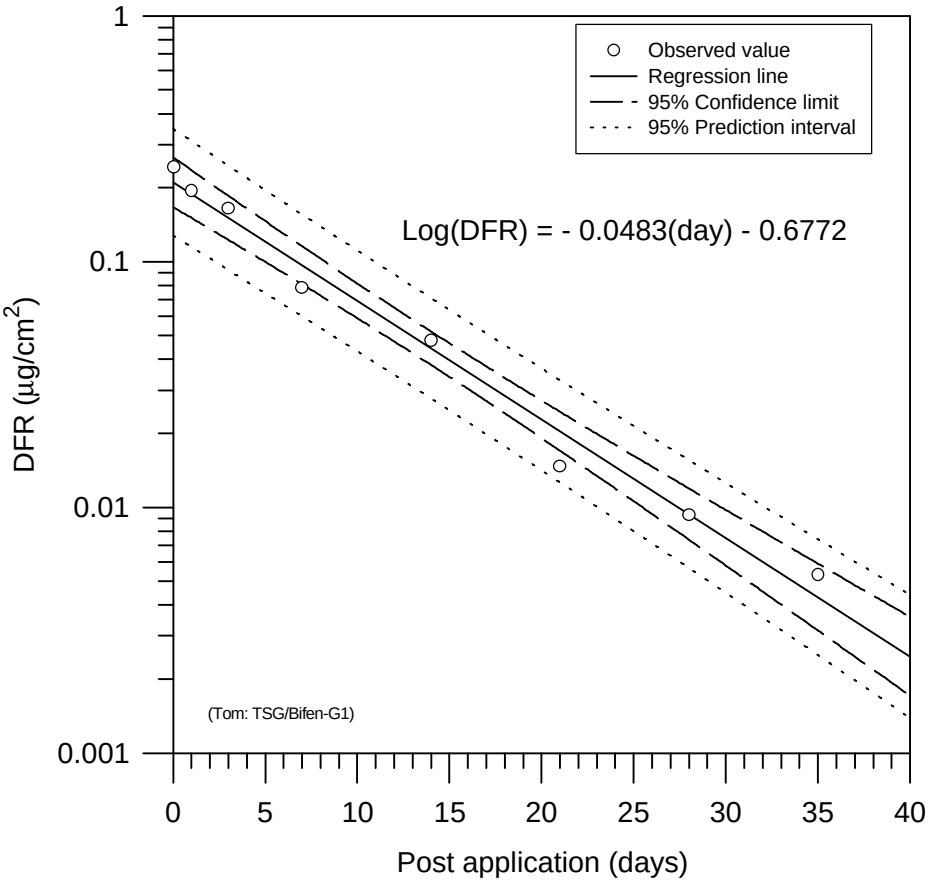
[c] Dermal exposure = ([b]) x 75.9 kg (BW).

[d] The upper bound values were calculated from the highest reported exposure rates by Lunchick (1988).

Surrogate DFR data used in the determination of exposure were obtained from two studies. One source was from the application of bifenthrin in cotton (Dong *et al.*, 1991); the other was from the application of fenpropathrin in grapes (Dong, 1994). Bifenthrin was applied at an application rate of 0.1 lbs a.i./acre at 7-day intervals. A log-linear regression line (Figure 3) was constructed

from field DFR data using the scientific graphing software SigmaPlot™ (Jandel Scientific, 1994a). The DFR data were also estimated for the 95% upper prediction limits. These data were adjusted for the difference in application rates of tralomethrin and bifenthrin. DFR data are shown in Table 5.

Figure 3. Dissipation of bifenthrin dislodgeable foliar residues on cotton



95% Confidence limits - also called the confidence interval for a regression, describe the range where the regression line values will fall 95% of the time for repeated measurements (Jandel Scientific, 1994b).

95% Prediction interval - also called the confidence interval for the population, describe the range where the data values will fall 95% of the time for repeated measurements (Jandel Scientific, 1994b).

The second set of surrogate DFR data were obtained from the application of fenpropathrin to grapes at a rate of 0.3 lbs a.i./acre. These data were adjusted to reflect the maximum label rate of tralomethrin at 0.024 lbs a.i./acre. Regression analysis and the determination of the upper 95% prediction limits were previously performed by Dong (1994). The results are shown in Table 5. The average DFR values from bifenthrin and fenpropathrin were used to estimate the exposure of cotton scouts to tralomethrin.

Potential dermal TFs were obtained from three studies conducted by Ware *et al*. (1973, 1974, 1975) in cotton using several pesticides. These studies were previously reviewed and the potential dermal TFs were reported for hand (950 cm^2/hr), upper body (1,020 cm^2/hr) and lower body (9,640 cm^2/hr) (Dong *et al.*, 1991). Cotton scouts are assumed to be wearing work clothing (long-sleeved shirts, long pants, socks and shoes) with or without chemical-resistant gloves. The average DFR data from one-day post application, following five applications at 7-day intervals, was used to estimate the dermal exposures. The exposure period for a cotton scout to treated foliage was assumed to be 6 hours per workday. A cotton scout is expected to spend more than two hours traveling between fields during a workday. In addition, not all cotton fields are expected to be treated with tralomethrin. This will also reduce the exposure time of a cotton scout to tralomethrin foliar residues. Results of the exposure estimates for hands, upper body, and lower body are shown in Table 5. Total exposure of a cotton scout based on protected and unprotected hands are summarized in Table 6.

Cotton scouts are assumed to have been exposed to tralomethrin for 40 days in a season of use (or in a year). This is based on the assumption that when tralomethrin is available commercially, not all cotton fields will be treated with this chemical. This exposure period has been used to estimate the exposure of bifenthrin (Dong *et al*., 1991) and fenpropathrin (Dong, 1994. The exposure of cotton scouts was estimated based on 40 workdays in a 62-day season. Absorbed dosages for short- and long-term exposures are shown in Table 8.

Table 5. Tralomethrin dislodgeable foliar residues in cotton and the estimation of dermal exposures[a].

A. Average exposure[b]

Post appl. (day)	(From bifenthrin) Adjusted DFR[e] (µg/cm^2)	(From fenpropathrin) Adjusted DFR[e] (µg/cm^2)	(Tralomethrin) Average DFR (µg/cm^2)	Dermal exposure of body parts to tralomethrin[c]			
				Hands		Upper body	Lower body
				With gloves	No gloves	(µg/person/day)	(µg/person/day)
				(µg/person/day)			
1	0.0452	0.0376	0.0414	23.6	236	25.3	239
2	0.0404	0.0336	0.0370	21.1	211	22.7	214
3	0.0362	0.0296	0.0329	18.7	187	20.1	190
4	0.0324	0.0256	0.0290	16.5	165	17.7	168
5	0.0290	0.0232	0.0261	14.9	149	16.0	151
6	0.0259	0.0200	0.0230	13.1	131	14.1	133
7	0.0232	0.0176	0.0204	11.6	116	12.5	118
10	0.0166	0.0120	0.0143	8.2	82	8.8	83
14	0.0107	0.0072	0.0089	5.1	51	5.5	52
21	0.0049	0.0032	0.0040	2.3	23	2.5	23

B. Upper 95% prediction limits[d]

Post appl. (day)	(From bifenthrin) Adjusted DFR[e] (µg/cm^2)	(From fenpropathrin) Adjusted DFR[e] (µg/cm^2)	(Tralomethrin) Average DFR (µg/cm^2)	Dermal exposure of body parts to tralomethrin			
				Hands		upper body	Lower body
				With gloves	No gloves	(µg/person/day)	(µg/person/day)
				(µg/person/day)			
1	0.0772	0.0896	0.0834	47.6	476	51.1	483
2	0.0688	0.0784	0.0736	41.9	420	45.1	426
3	0.0613	0.0688	0.0651	37.1	371	39.8	376
4	0.0547	0.0608	0.0577	32.9	329	35.3	334
5	0.0488	0.0536	0.0512	29.2	292	31.3	296
6	0.0435	0.0472	0.0454	25.9	259	27.8	262
7	0.0389	0.0416	0.0402	22.9	229	24.6	233
10	0.0277	0.0280	0.0278	15.9	159	17.0	161
14	0.0177	0.0168	0.0173	9.8	98	10.6	100
21	0.0082	0.0072	0.0077	4.4	44	4.7	45

[a] Application rates (lbs a.i./acre): bifenthrin = 0.1, fenpropathrin = 0.3, tralomethrin = 0.024. DFR data were based on two sides of leaf surfaces. Exposure estimates were based on 6 hours per workday. Cotton scouts are assumed to be wearing long-sleeved shirts, long pants, socks and shoes, and gloves (or no gloves).

[b] DFR data, after five applications and at 7-day intervals, were determined from a regression line using SigmaPlot™ (Jandel Scientific, 1994a).

[c] Geometric mean potential dermal transfer factors (cm^2/hr) are: hands = 950, upper body = 1,020, lower body = 9,640. Cotton gloves provide 90% exposure protection for hands of scouts (Aprea *et al*., 1994).

[d] Obtained from the regression analysis using SigmaPlot™ (Jandel Scientific, 1994a).

[e] Bifenthrin and fenpropathrin DFR data were adjusted to reflect the application rate of tralomethrin at 0.024 lbs a.i./acre.

Table 6. Summary: Exposure of cotton scouts to tralomethrin one day post application.

	Exposure (µg/person/day)							
	Average				upper 95% prediction limits			
	Hands	Upper body	Lower body	Total	Hands	Upper body	Lower body	Total
No gloves	236	25.3	239	501	476	51.1	483	1009
Cotton gloves	23.6	25.3	239	288	47.6	51.1	483	581

2. Use of tralomethrin in residential and structural pest controls

A. Residential application by PCOs (broadcast)

A tralomethrin product, Sega® WP (40% w/w), can be purchased and applied only by PCOs. This product may be applied in and around homes and commercial structures for residual control of major nuisance pests, such as for premise pest control (cockroaches, ants, crickets, silver fish, etc.), pantry pest control (grain weevils, flour beetles, etc.), and localized control of termites, carpenter ants and carpenter bees. The maximum concentration of tralomethrin in spray solution is 0.06%. For long residual pest control, use 2.26 grams of tralomethrin (0.2 ounces of Sega® WP) in sufficient water to cover 1,000 ft^2.

Significant exposure is likely to occur to PCOs, who mix, load and apply this product, to infants, who play on treated surfaces and to adults, who reside in treated homes. The exposure estimate for M/L/As was obtained from a study using chlorpyrifos (Gibbons, 1993) and that for infants and adults were from a broadcast application of chlorpyrifos (Vacarro *et al*., 1991). The latter was previously reviewed and reported (Thongsinthusak *et al*., 1993a).

A.1 M/L/A

Three PCOs performed "lawn/perimeter" sprayings around customers' homes, using an application rate of 0.005 lbs of chlorpyrifos per gallon of dilution water (0.06%). The applications were accomplished using a high-pressure system equipped with a gun-type application wand. One pre-exposure sample and 6 days of post-exposure urine voids were collected and analyzed for 3,5,6-trichloro-2- pyridinol (TCP), a major urinary metabolite of chlorpyrifos, and creatinine level. The average of TCP excretion for three applicators was 63.0 ± 6.0 μg per day (Table 7). Absorbed dosages for chlorpyrifos and tralomethrin were calculated by an equation shown in the footnotes of Table 7. AADD and LADD were calculated and shown in Table 9.

A.2 Infants (residual contacts)

The exposures of infants and adults to tralomethrin were estimated from a broadcast application of a 0.5% chlorpyrifos emulsion (Vacarro *et al*., 1991). A certified applicator treated 8 carpeted rooms at two houses with Dursban® LO. This study composed of physicochemical phase, dislodgeable residue study using a drag system, and dermal exposure of adults to treated surface. The treated rooms were ventilated for two hours after application. Six adult volunteers participated in the dermal exposure study. All of them wore only bathing trunks to simulate unclothed infants wearing only diapers. These volunteers were instructed to simulate prescribed infant movements for four hours, such as crawling, playing with blocks, walking, and lying on the backs or abdomens in the treated rooms. At the end of the four hour activities, hand rinses were collected from each participant using an ionic surfactant. All participants were allowed to shower thereafter.

Table 7. Determination of tralomethrin absorbed daily dosage of a pest control operator.

	Excreted TCP (μg/person/day)	Adjusted excreted chlorpyrifos[a] (μg/person/day)	Adjusted ADD chlorpyrifos[b] (μg/kg/day)	Adjusted ADD tralomethrin[c] (μg/kg/day)
Average (n = 3)	63.0	111.4	2.10	1.57
Lower range	56.5	99.9	1.88	1.41
Upper range	68.4	120.9	2.28	1.71

[a] Amount of TCP excreted was corrected for MW of chlorpyrifos (351). ([a]) = TCP x 351 ÷ 198.5.

[b] 70% of absorbed dose from oral administration of chlorpyrifos was excreted in urine (Nolan *et al.*, 1984). ([b]) = ([a]) ÷ (70% x 75.9 kg).

[c] Adjusted for % dermal absorption of chlorpyrifos (9.6%) and tralomethrin (7.2%). ([c]) = ([b]) x 7.2% ÷ 9.6% (Assumed inhalation exposure was negligible).

Urine voids were collected at pre-exposure and daily for five days after the exposure. Urine samples were analyzed for TCP and creatinine levels. The estimation of the chlorpyrifos exposure for infants was based on 6 hours of activities and 18 hours of rest. For infants, the average chlorpyrifos ADD ± SD from dermal exposure was estimated to be 22.2 ± 12.6 μg/kg/day and that from oral dose was 8.7 ± 3.0 μg/kg/day (Thongsinthusak *et al.*, 1993a). These surrogate exposures were adjusted to reflect a maximum label rate of tralomethrin at 0.06% and a dermal absorption value of 7.2% (chlorpyrifos = 9.6%). Tralomethrin ADD was estimated to be 3.04 ± 1.49 μg/kg/day (Table 9). Inhalation exposure was assumed to be negligible because tralomethrin has a very low vapor pressure.

A.3 Adults (residual contacts)

For adults, the average ADD ± SD from dermal exposure to chlorpyrifos was estimated to be 17.2 ± 9.84 μg/kg/day and that from oral dose was 0.3 μg/kg/day (Thongsinthusak *et al.*, 1993a). These exposure estimates were derived from a study conducted by Vacarro *et al.* (1991). Inhalation exposure was assumed to be negligible and not included in the calculation. The exposures were adjusted to reflect percent tralomethrin in application suspension of 0.06% and a dermal absorption value of 7.2%. ADD was estimated to be 1.58 ± 0.89 μg/kg/day (Table 9).

B. Application by homeowners (cracks, crevices, and spots sprays)

B.1 Home applicators

The exposure estimate of home applicators was based on the application of a tralomethrin finished product that has the highest active ingredient of 0.03%. The exposure estimate for an application using 1% propoxur aerosol (Sanborn, 1994) was employed as a surrogate. Application of propoxur aerosol resulted in a geometric mean (GM) dermal exposure of 0.85 mg/person/day with a geometric standard deviation (GSD) of 2.6. Inhalation exposure, GM(GSD), was 0.03 (1.7) mg/person/day. The exposures were adjusted for the difference in percent of active ingredients in the solution. The results are shown in Table 9.

B.2 Infants (residue contacts)

Exposure of infants, via both dermal and oral routes, to tralomethrin (T) was estimated based on dislodgeable residue data generated by Vacarro *et al*. (1991) using chlorpyrifos (C). An adjustment of surrogate data was made regarding contact area, the difference of tralomethrin and chlorpyrifos application rates, transfer rate, and the surface to body weight ratio of infant and adult. It was estimated that an infant may contact residue in an area of 8 ft^2 of a standard room (12ft x 12 ft). It was assumed that a swath width along the floor and baseboard was 8 inches (one half was on the floor and one half was on the wall). Further, the probability of an infant contacting treated surface was assumed to be 25%. The contact area from spot treatment was assumed to be 2ft x 2ft (or 4 ft^2) for a standard room. Therefore, the total contact area was determined to be 8ft^2 [(1/3 ft (swath width on the floor) x 12 ft/side x 4 sides x 25%) + (4ft^2 for spot treatment)]. The surface area to body weight between an infant and an adult (correction factor) was 1.52 (Lawyer, 1994).

Average dislodgeable residue (± SD) from a chlorpyrifos application was 22.3 ± 9.4 μg/ft^2 (Vacarro *et al*., 1991). Estimated dermal dose for infants was calculated as follows:

= [(22.3 μg/ft^2 x 8 ft^2 x 1,100 μg/ft^2 /11,828 μg/ft^2 (use rates of T/C) x 1.52 (correction factor)]/(10.2 kg BW)

= 2.47 μg/kg/day

ADD = 2.47 x 7.2% (dermal absorption rate) = 0.18 μg/kg/day

Oral exposure was calculated based on the transfer of 474 μg of hand residue from 43.1 ft^2· This hand residue was adjusted to reflect the hand size of an infant (1/4 of adult), use rate and possible contact surface area of 8 ft^2. Calculation of oral dose is shown below.

= [(474 μg hand residue/43.1 ft^2) x 0.25 (hand size ratio) x 8 ft^2 (contact area) x 1,100 μg/ft^2 /11,828 μg/ft^2 (use rates of T/C)] / (10.2 kg BW)

= 0.2 μg/kg/day

Total infant exposure (ADD) = 0.18 + 0.20 = 0.38 μg/kg/day

A calculation procedure for standard deviations was similar to that used to calculate the average value. Results are shown in Table 9.

The number of exposure days for infants or adults who reside in homes treated with tralomethrin, either by PCOs or by home owners, were estimated as follows:

Assumed a number of tralomethrin applications per year (during summer, spring, and fall) = 3 (According to product labels, residual control of each application may last up to 3 months).

Exposure period to high level of surface residues per application = 5 days (Assumed loss of dislodgeable residues due mainly to repeated contacts by home occupants).

Total number of exposure days per year to a high level of residues = 3 x 5 = 15 days.

Table 8. Exposure of handlers and cotton scouts to tralomethrin from use in agriculture[a].

Work task	n	Exposure (µg/person/day) Dermal	Inhalation	ADD (µg/kg/day)	SADD (µg/kg/day)	AADD (µg/kg/day)	LADD (µg/kg/day)
A. Agriculture: aerial application							
A.1 M/L[b]	16	628 ± 689	35 ± 15	0.82 ± 0.65	0.67	0.11	0.06
A.2 A[c]	16	504 ± 683	1.7 ± 0.5	0.49 ± 0.65	0.40	0.07	0.04
A.3 Flaggers[d]	11	76 (455)	11.9	0.18 (0.53)	0.14	0.02	0.013
B. Agriculture: ground boom application							
B.1 M/L[e]	13	15.2 (45.5)	negligible	0.02 (0.04)	0.006	0.001	0.001
B.2 A[f]	15	61.0 (463)	negligible	0.06 (0.44)	0.019	0.003	0.002
C. Cotton scouts (gloved hands)[g]		288 (581)	negligible	0.27 (0.55)	0.18	0.03	0.02
(no gloves)[g]		501 (1009)	negligible	0.48 (0.96)	0.31	0.05	0.03

n = number of replicate

[a] The following factors were used in the estimation of exposures: adult male body weight = 75.9 kg (U.S. EPA, 1985), dermal absorption rate = 7.2% (Thongsinthusak, 1993), inhalation uptake/absorption = 50% (Raabe, 1988), years of employment = 40 years (default value), life expectancy = 75 years (Bureau of the Census, 1991).

[b] Exposure represents average ± SD. Assumed 50 workdays (Hoechst-Roussel, 1992) in a 62-day season (Meinders *et al.*, 1991). Mixers/loaders wore long-sleeved coveralls (or long-sleeved shirts, long pants), shoes or boots, goggles, chemical-resistant gloves, and caps. These clothing and equipment are similar to those required by tralomethrin product label.

[c] Exposure represents average ± SD. Assumed 50 workdays (Hoechst-Roussel, 1992) in a 62-day season. Pilots wore long-sleeved flight suit (or long-sleeved shirts, long pants), shoes or boots, goggles, and fire resistant gloves. These clothing and equipment are similar to those required by tralomethrin product label.

[d] The results represent average (and the highest) exposure rates. Assumed 50 workdays (Hoechst-Roussel, 1992) in a 62-day season (or a year). Flaggers were assumed to have worn long-sleeved shirts, long pants, goggles, socks and shoes, and protective gloves.

[e] The results represent average (and the highest) exposure rate. Assumed 20 workdays (Meinders and Krieger, 1988) in a 62-day season (or a year) for ground boom application. Mixers/loaders were assumed to have worn long-sleeved shirts, long pants, goggles, socks and shoes, and protective gloves.

[f] The results represent average (and the highest) exposure rate. Assumed 20 workdays (Meinders and Krieger, 1988) in a 62-day use season (or per year) for ground boom application. Applicators were assumed to have worn long-sleeved shirts, long pants, goggles, and protective gloves.

[g] The results represent average (upper 95% prediction limits). Cotton scouts were assumed to be working 6 hours per workday and 40 days (Meinders and Krieger, 1988) in a 62-day use season (or in a year).

Table 9. Exposure of pest control operators and residents to tralomethrin from indoor and outdoor uses[a].

Work task	n	Exposure (µg/person/day) Dermal	Oral	Inhalation	ADD (µg/kg/day)	AADD (µg/kg/day)	LADD (µg/kg/day)
A. Residential application by PCOs (broadcast)							
A.1 M/L/A[b]	3	N/A	N/A	N/A	1.57 (1.41 - 1.71)	0.96	0.55
A.2 Infants (residual contacts)[c]	6	20.4 ± 11.5 (ADD)	11.5 (ADD)	negligible	3.04 ± 1.49	0.13	N/A
A.3 Adults (residual contacts)[d]	6	117 ± 67.6 (ADD)	2.73 (ADD)	negligible	1.58 ± 0.89	0.06	0.03
B. Application by homeowners (cracks, crevices, spots)							
B.1 Home applicators[e]	32	25.5 (78.0)	N/A	9.0 (51)	0.03 (0.41)	0.0003	0.0001
B.2 Infants (residue contact)[f]	6	25.2 ± 10.6	2.05	negligible	0.38 ± 0.28	0.016	N/A

n = number of replicate N/A = not applicable

[a] The following factors were used in the estimation of exposures: adult male body weight = 75.9 kg (U.S. EPA, 1985), infant body weight = 10.2 kg (ICRP, 1974), dermal absorption value = 7.2%, inhalation uptake/absorption = 50%. Years of employment (where applicable) is 40 years in a 75-year lifetime (Bureau of the Census, 1991).

[b] ADD represents average (and the range). The application rate was 0.005 lbs chlorpyrifos/gallon of water (0.06 %). The applications were conducted for 12 locations/day. Workers wore long-sleeved shirts, long pants, eye protection, and chemical-resistant gloves and boots. Data were obtained from a biological monitoring study of chlorpyrifos. The number of workdays per year is 223 days (Munro, 1992).

[c] ADD represents average ± SD. The number of days exposed per year for infants was assumed to be 15 days (3 applications/year x 5 days/application). LADD for infants was not estimated. Infants were assumed to be wearing diapers.

[d] ADD represents average ± SD. The number of days exposed per year for adults was assumed to be 15 days (3 applications/year x 5 days/application). Adults were assumed to be wearing minimal clothing.

[e] Exposures represent GM (GSD). The number of days exposed per year for adults was assumed to be 3 days per year.

[f] Exposures represent average ± SD. The number of days exposed per year for infants was assumed to be 15 days (3 applications /year x 5 exposure days/application).

Notes: negligible - inhalation exposure (infants and adults) was estimated to be less than 2.2×10^{-7} µg/kg/day (Lawyer, 1994).

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